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Title: Fabrication of DFBX Instrumentation Assembly, MQX2

1. PURPOSE

The purpose of this document is to identify the steps that will be necessary to fabricate the MQX2 assemblies at LBNL. The assemblies will be shipped to the DFBX Subcontractor for integration into the completed DFBX.

2. SCOPE

This document is limited to the fabrication and test of the MQX2 assemblies at LBNL.

3. REFERENCE DOCUMENTS

4. LIST OF ACTIVITIES

The list of steps presented here are based on a preliminary assembly concept. The detailed steps are being worked out at FNAL, and the steps herein will be modified as needed after the FNAL development work is completed.

Note: MQX2 – there are 8 of these required. Reference drawing 25I301

Each duct contains a minimum of 100 Kapton-insulated wires of about 11 ft length :

32 each 30 AWG for temperature sensors (plus spares?)

36 each 26 AWG for voltage taps (plus spares?)

32 each 18 AWG for quench protection and warm-up heaters (probably don't need spares)

- 4.1. Fabricate the empty stainless steel conduit according to 25I301. Make sure the tube edges on details E and K are chamfered to prevent the wire from being scuffed.
- 4.2. Using a flexible borescope, inspect the tube to ensure that the inner diameter is free of weld metal drop in and other restrictions.
- 4.3. Install bolt-on vacuum leak/pressure test fittings to the ends and perform a vacuum leak check. The leak rate shall be less than 1×10^{-9} atm cc/sec (helium).
- 4.4. Remove the fittings and thermal cycle the assembly 5 times from RT to LN temperature
- 4.5. Warm to room temp and dry the assembly, especially the convolutions of the welded bellows.
- 4.6. Re-install bolt-on vacuum leak/pressure test fittings to the ends and perform a vacuum leak check. The leak rate shall be less than 1×10^{-9} atm cc/sec (helium).
- 4.7. Pressurize to 25 bar gauge (370 psig), hold for 10 minutes at pressure. Drop the pressure to 20 bar gauge (290 psig) and measure the diameters of the weld areas to verify that there is no permanent deformation.

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- 4.8. Repeat the vacuum leak test to show that the leak rate is less than 1×10^{-9} atm cc/sec (helium).
 - 4.9. Connect wires to the Hypertronics connector according to the wiring diagram.
 - 4.10. Bundle the wires into groupings according to size
 - 4.11. Place the 30 AWG wires at the center of the assembly
 - 4.12. Place the 26 AWG wires around the 30 AWG core
 - 4.13. Place the 18 AWG wires around the 26 AWG ring
 - 4.14. Insulating spacers or spare wires as needed to fill the space that will be at LN temperature or lower
 - 4.15. Loosely wrap the bundle with a barber-pole wrap of Kevlar string
 - 4.16. Cover the free end of each wire with teflon sleeving and overwrap the entire bundle with Al foil.
 - 4.17. Hipot the wires. During a hipot test of a given wire, all others are at ground potential, along with the aluminum foil wrap. The 30 AWG wires shall be hipotted to 600 VDC, and the 26 AWG and 18 AWG wires shall be hipotted to 5 kVDC. Leakage current to be less than 20 microamps after 30 sec.
 - 4.18. Remove the aluminum foil wrap and place a 20 ft length of braided fiberglass sleeving (Chinese handcuffs) over the bundle.
 - 4.19. Feed the sleeving into the bellows end and push through to the small flange end.
 - 4.20. Feed the wire bundle though by pulling on the sleeving and pushing on the other end. We need 48 inch of wire past the small flange end and about 24 inch protruding from the bellows end.
 - 4.21. Separate the wires, trim $\frac{1}{4}$ inch of insulation and tin the wire ends with 60/40 solder. Do this for both ends.
 - 4.22. Plug the wires into a breakout panel that allows a continuity test and hipot test to be made on the wires. **Note that the wires are separated according to size and function.**
 - 4.23. Using a buzz box, correlate the two ends of each wire and label the free end.
 - 4.24. Redo the hi pot test of all wires. During a hipot test of a given wire, all others are at ground potential, along with the stainless steel conduit. The 30 AWG wires shall be hipotted to 600 VDC, and the 26 AWG and 18 AWG wires shall be hipotted to 5 kVDC.
 - 4.25. Cap the bellows end with the vacuum/pressure bolt-on fixture.
 - 4.26. Release the wires from the breakout panel on the non bellows end and gather them into a neat bundle. Wrap in a protective plastic film.
 - 4.27. Attach "pressure tested" tag to the assembly, complete the traveler, and package it along with the instrumentation duct for shipment to the DFBX vendor.